ENTOMOLOGY.—*The North American empoascan leafhoppers of the* radiata *group (Homoptera: Cicadellidae).*[1] NANCY H. WHEELER,[2] U. S. Bureau of Entomology and Plant Quarantine. (Communicated by J. S. Wade.)

The species of leafhoppers treated in this paper are characterized by a strongly produced crown, tending to be bluntly pointed, with the median length almost as long as, or in some cases longer than, the narrowest interocular space. The species of this group range in length from 2.75 to 3.75 mm. They are frequently well marked with distinctive color patterns and are usually easily distinguishable externally. However, from a study of the group in general, and from an examination of extensive western collections in particular, it appears obvious that several of the closely related species can be differentiated readily and accurately only by examination of the structures of the internal male genitalia.

Some of the species here discussed were originally included by DeLong[3] in the subgenus *Idona*, which he established with *minuenda* Ball[4] as the type, on the basis of the shape of the head. In addition to the type, he included in this subgenus *panda* DeLong, *junipera* DeLong, *elongata* DeLong, *rufa* DeLong, *tincta* DeLong, *morrisoni* Hartzell, *radiata* Gillette, and *mexicana* Gillette. Later, McAtee[5] pointed out reliable venational characters and raised *Idona*, with *minuenda* as the type, from subgeneric to generic rank, stating that "some of the other species certainly, and all of them probably, can well remain in the typical subgenus of *Empoasca* Walsh."

In view of the uncertain status of this group, a careful examination has been made of all available type material of the species involved. As a result, some synonymical changes are recorded and the group, of which *radiata* is a typical example, is redefined and considered as a part of the subgenus *Empoasca* Walsh. Only four of the original species are included in this *radiata* group, and, on the basis of the characters defining the group, *elongata*, *morrisoni*, and *panda* (because of their larger size and more rounded crown) are excluded and referred to the *fabae* group; *mexicana* Gillette, which will have as a

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[2] In the preparation of this paper the writer has had access to the U. S. National Museum collections and expresses her thanks to P. W. Oman, of the Division of Insect Identification, Bureau of Entomology and Plant Quarantine, for his cooperation and helpful criticism, and to Dr. R. H. Beamer, Dr. D. M. DeLong, and E. P. Van Duzee for loan of valuable material for comparison.

[3] U. S. Dept. Agr. Tech. Bull. **231**: 1–59. 1931.

[4] Proc. Biol. Soc. Washington **34**: 23–24. 1921.

[5] Proc. Zool. Soc. London, 1934, pt. 1: 107. 1934.

synonym *bitubera* DeLong, 1932,[6] is referred to the *alboneura* group; while *occidentalis*,[7] subsequently described by DeLong and Davidson, is placed in the *radiata* group. Another species, *ruficeps*, described in 1917 by Van Duzee from external characters only, apparently belongs to this group but was not included by DeLong in his revision of the genus.

This paper includes the description and illustrations of the internal male genital characters of *ruficeps*, together with those of five other species of the *radiata* group, four of them new to science. Three illustrations of each species are given, depicting both lateral and ventral views of the male genital capsule, and the ventral view of the sternal apodemes, and each drawing shows an enlargement of approximately 70 diameters.

The following key is presented as an aid in the separation of the species of the *radiata* group[8] now known to occur in North America.

KEY TO THE SPECIES OF THE RADIATA GROUP

A. Fore wing without definite gray or brown spots, and consequently without a mottled appearance.
  B. Posterior margin of seventh sternite of female with a median slightly produced lobe or tooth and a slight indentation on each side of it. General color olivaceous-green ..... *junipera* DeLong
  BB. Posterior margin of seventh sternite of female not as above. General color yellowish, orange, or testaceous-green.
    C. Fore wing with orange or brownish stripes along the claval suture. Lateral processes, in ventral view, with apices curved laterad ..... *radiata* Gillette
    CC. Fore wing without stripes along claval suture. Lateral processes, in ventral view, with apices not curved laterad.
      D. Fore wing tinged with testaceous. Lateral process, in ventral view, terminating in a small hook curved mesad ..... *tincta* DeLong

[6] Ohio Journ. Sci. 32(4): 395. 1932.
[7] Ohio Journ. Sci. 35(1): 32–33. 1935.
[8] After this manuscript was submitted for publication, Davidson and DeLong (Ohio Journ. Sci. 39(2): 110–118. 1939) published descriptions of *Empoasca dorothyi*, *E. galluxa*, and *E. ancistra*, which apparently belong to the *radiata* group. Subsequent study of male paratypes of these species indicates that the first two bear a close resemblance, both externally and internally, to the species herein described as *E. crepidula*. The single specimen of each species available for examination may be differentiated by the relative length of the lateral process and the curvature of the apical portion of this process. In *dorothyi* and *galluxa*, the lateral process in ventral view is longer than in *crepidula*, but the apical portion is less curved mesad in *dorothyi* than in either *crepidula* or *galluxa*. It is possible that *crepidula* may prove to be an extreme variation of *dorothyi* and that a study of a longer series in each case, particularly of abundant material from northern Arizona, may show that *dorothyi*, *galluxa*, and *crepidula* are variants of a single species. The species described as *ancistra* is apparently close to what has been identified as *radiata* Gillette, but, since the male type of *radiata*, supposedly in the U. S. National Museum collection, can not be located, there is some question as to the proper identity of that species and decision in this matter must await further study.

DD. Fore wing tinged with smoky green or orange. Lateral process, in ventral view, without terminal hook.
E. Fore wing tinged with smoky green across center of clavus and apex, giving a banded appearance. Posterior margin of seventh sternite of female with a shallow median quadrangular emargination ..... *occidentalis* DeLong and Davidson
EE. Fore wing tinged with orange, without banded appearance. Posterior margin of seventh sternite of female produced and rounded, without median quadrangular emargination.
F. Lateral process, in lateral view, relatively short and bluntly pointed ..... *crepidula*, n. sp.
FF. Lateral process, in lateral view, long and sharply pointed ..... *acuminata*, n. sp.

AA. Fore wing with definite gray or brown spots, giving a mottled appearance.
B. Head with a network of red pigmentation. Fore wing greenish white mottled with gray.
C. Lateral processes, in ventral view, crossed medially, their apices produced and curved inward ..... *erythrocephala*, n. nom.
CC. Lateral processes, in ventral view, not crossed medially, their apices bluntly rounded and divergent ..... *rubrarea*, n. sp.
BB. Head without a network of red pigmentation. Fore wing yellowish green mottled with orange, gray, or brown.
C. Lateral processes, in ventral view, crossed medially, their apices produced and overlapping ..... *ruficeps* Van Duzee
CC. Lateral processes, in ventral view, not crossed medially.
D. Lateral process, in lateral view, with apex sharply pointed and curved dorsad .... *rubrarea* var. *indistincta*, n. var.
DD. Lateral process, in lateral view, with apex bluntly pointed and curved ventrad ..... *delta*, n. sp.

Empoasca crepidula, n. sp. Fig. 1

Superficially resembling *occidentalis* but more yellowish and lacking banded appearance, and with a shorter lateral pygofer process and a small slipperlike spine. Length 3.75 mm.

External characters.—General color dull yellowish green tinged with orange. Crown irregularly marked with indistinct white areas. Pronotum with three large white spots along anterior margin. Scutellum with a median white stripe and a large white dot in center near apex, with a much smaller dot on each side. Fore wing subhyaline, with apex faintly fuscous. Seventh sternite of female with posterior margin slightly produced and rounded not notched medially.

Male internal structures.—Lateral process relatively short, extending only slightly beyond tip of style; in lateral view curving dorso-caudad, with apex appearing bluntly pointed; in ventral view broadly sinuate, with apical half curving gradually mesad and tapering to a point. Dorsal spine narrow at base and broadening into a small sharply pointed slipperlike shape with apex directed ventrocephalad. Sternal apodemes long and slender, bluntly rounded distally.

Described from one male and two females collected at Oak Creek Canyon, Ariz., August 9, 1932, by R. H. Beamer.

Holotype male and allotype and paratype females deposited in the Snow Entomological Collection, Lawrence, Kans.

Empoasca acuminata, n. sp. Fig. 2

A dull yellowish-green species, with long-pointed lateral process. Length 3.2 mm.

External characters.—General color dull yellowish green tinged with orange. Crown with median white line constricted at middle and with two oblique white dashes on each side near eye. Pronotum with four irregular white spots along anterior margin, median pair almost contiguous. Scutellum with median white area and three white spots near apex along incised line. Fore wing subhyaline, tinged with orange. Seventh sternite of female with posterior margin produced and rounded.

Male internal structures.—Lateral process long and pointed, slender at base and gradually broadening toward middle, with apical fourth tapering to long slender point directed caudad. Dorsal spine broad at base, with apical portion bluntly rounded and extending ventrad. Sternal apodemes large and saclike.

Holotype male, allotype female, and 12 male and 8 female paratypes from Nogales, Ariz., October 20, 1937, P. W. Oman, collector.

Type, U. S. N. M. no. 53285. Four paratypes deposited in collection of the entomological laboratory of the U. S. Bureau of Entomology and Plant Quarantine, Arlington Experiment Farm, Arlington, Va.

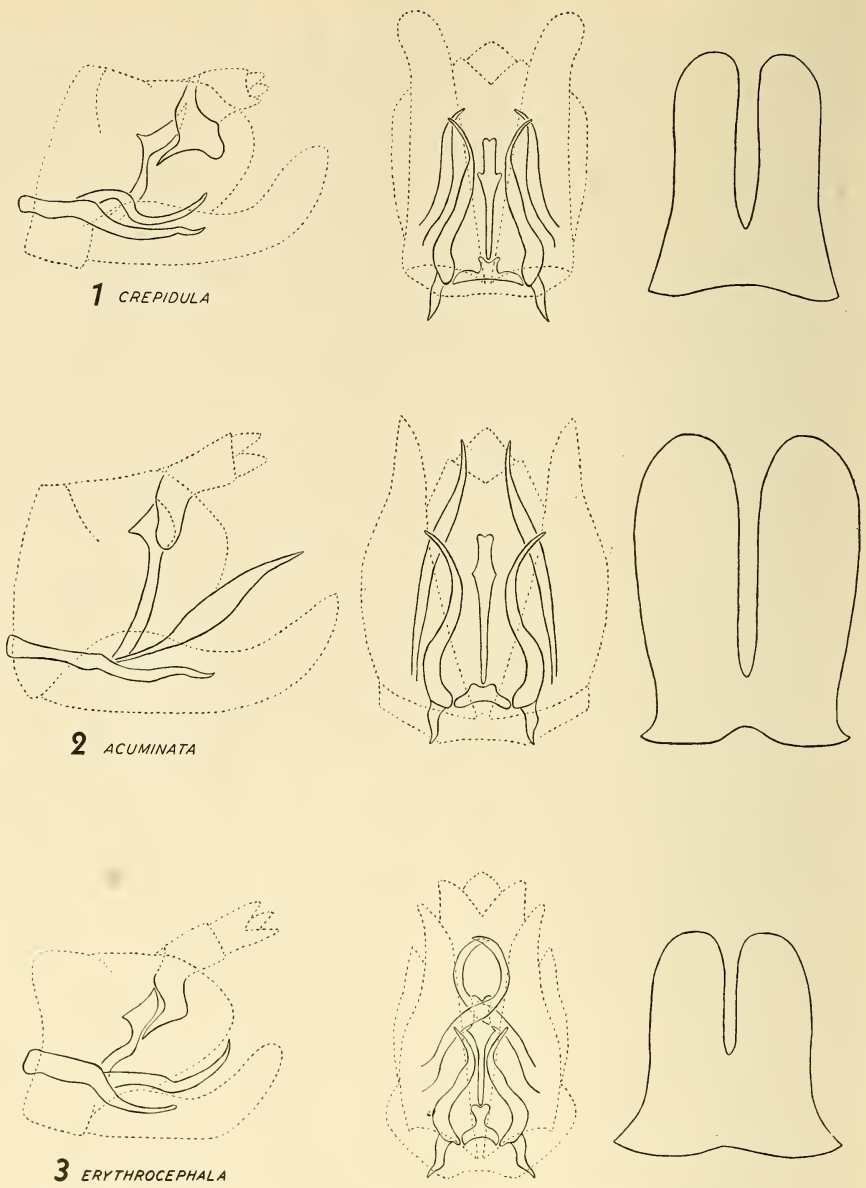
Empoasca erythrocephala, new name Fig. 3

Empoasca rufa DeLong (*nec* Melichar, Homop.-Fauna v. Ceylon: 212. 1903), U. S. Dept. Agr. Tech. Bull. 231:53–54. 1931.

From specimens collected at Pasadena, Calif., DeLong, in 1931, described as *Empoasca rufa* DeLong (*nec* Melichar) a small (3.2 mm) white species with reddish mottling on the head and with crown bluntly pointed. Melichar in 1903, from external characters only, had previously described as *E. rufa*, a scarlet-red, foreign species, 4 1/5 mm in length, illustrating the head, fore wing, and hind wing. From a study of the illustrations and the description of Melichar's species, and from a comparison with specimens in the U. S. National Museum collection, which appear to be that species, *rufa* Melichar is considered representative of an oriental group of *Empoasca* having no close relation with the *radiata* group. DeLong's species is therefore given the new name *erythrocephala* and is reillustrated, for the purpose of comparison with other closely related species, from specimens collected by R. H. Beamer at Claremont, Calif. The types of *rufa* DeLong are in the collection of E. D. Ball.

Empoasca rubrarea, n. sp. Fig. 4

Superficially resembling *erythrocephala*, but with a shorter dorsal spine and the lateral processes in ventral view not crossed in the middle. Length 2.75–3 mm.



Figs. 1–3.—Lateral and ventral views of male genital capsule and ventral view of sternal apodemes of (1) *Empoasca crepidula*, n. sp., (2) *E. acuminata*, n. sp., and (3) *E. erythrocephala*, new name. × ca. 70.

External characters.—General color pale greenish white, with the network of bright red pigmentation on upper portion of face and crown less heavily outlined than in *erythrocephala;* irregularly marked with red on pronotum and scutellum and on base and costal margin of fore wing. Fore wing also flecked with small gray spots, the larger spot on middle of clavus along com-

missural line much darker and more distinct than in *erythrocephala;* apex fuscous, with pale nervures. Seventh sternite of female slightly produced and rounded posteriorly.

Male internal structures.—Lateral process in lateral view relatively stout, curving dorso-caudad, with dorsal margin slightly concave at distal portion, terminating in a sharply pointed apex directed dorsad; in ventral view curving mesad, then caudad, with distal portion slightly enlarged and bluntly rounded. Dorsal spine rather indistinct, slightly broader at base, deeply concave on cephalic margin and curved to sharply pointed apex directed ventrocephalad. Aedeagus broad distally. Sternal apodemes medium sized, bluntly rounded distally.

Described from a series of 53 males and 93 females collected by R. H. Beamer, July 24, 1935, in Santa Barbara County Park, 13 miles east of Nipomo, Calif., labeled "Nipomo, Cal." There are also at hand collections by R. H. Beamer consisting of one male from Claremont, Calif., July 29, 1935, and 14 males and 20 females from Topango Canyon, Calif., August 5, 1938.

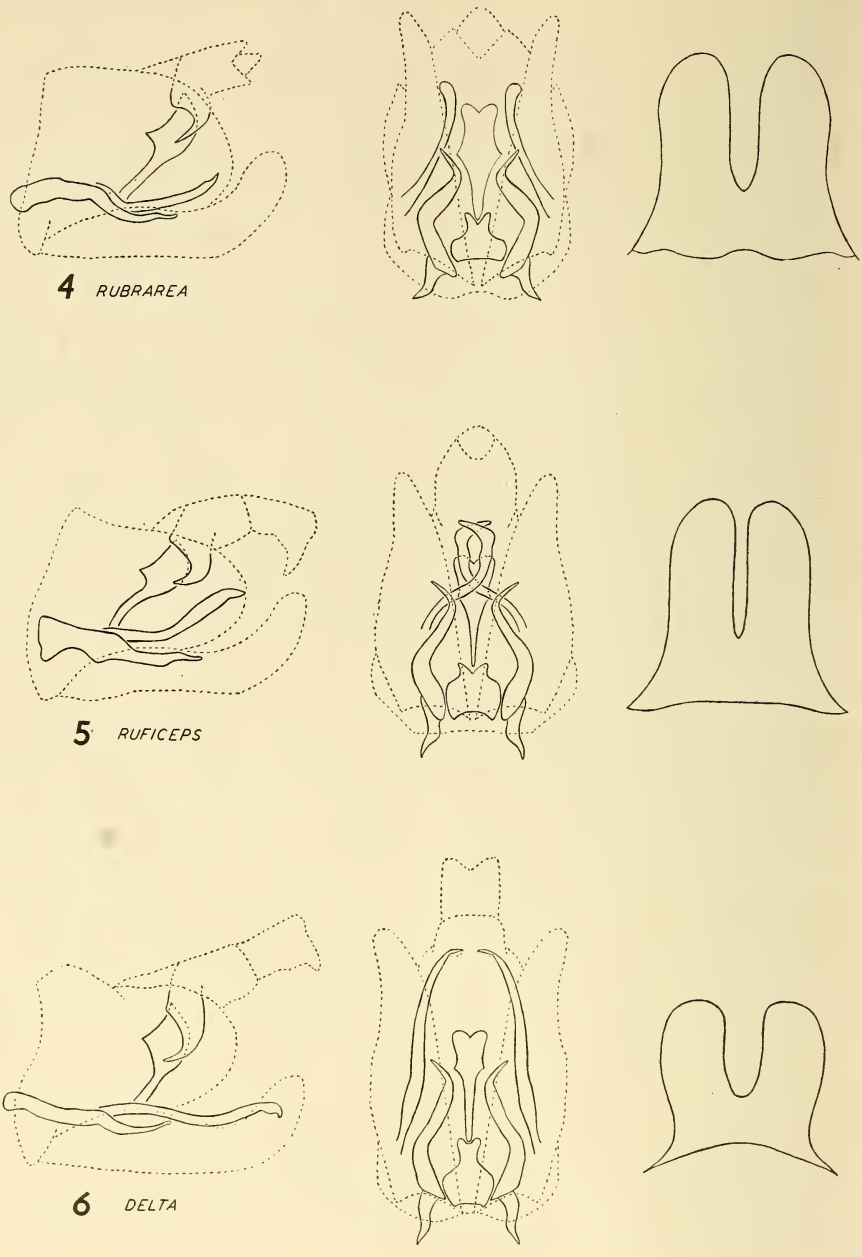
Holotype male, allotype female, and 25 male and 45 female paratypes deposited in the Snow Entomological Collection, Lawrence, Kans.; 15 male and 15 female paratypes deposited in the U. S. National Museum (no. 53286); 12 male and 32 female paratypes deposited in the collection of the entomological laboratory of the Bureau of Entomology and Plant Quarantine at the Arlington Experiment Farm, Arlington, Va.

Empoasca rubrarea var. **indistincta,** n. var.

Agreeing with *rubrarea* in general form and with identical internal genital structures, but more yellowish in color and lacking the network of bright red pigmentation on head and other red markings. Length 2.75–3 mm.

External characters.—General color yellowish green. Crown tinged with orange, with four small white spots along anterior margin, a larger spot on each side near eye, and a white median area constricted in middle, sometimes forming two distinctly separated spots. Pronotum and scutellum tinged with orange, the former with three larger white spots along anterior margin and the latter with a median white spot near anterior margin and three smaller white spots along the incised line. Fore wing mottled with orange and more sparsely flecked with gray than *rubrarea,* but with a similar, distinct, fuscous spot on middle of clavus, and apex fuscous with pale nervures. Seventh sternite of female like that of *rubrarea.*

Holotype male, allotype female, and 8 male and 8 female paratypes from Monterey, Calif., July 22, 1935, collected by R. H. Beamer. Other paratypes as follows: One male from Cajon, Calif., June 6, 1935, and 1 male from Mint Canyon, Calif., June 7, 1935, collected by P. W. Oman; 1 male and 2 females, Beaumont, Calif., July 26, 1933, 2 males and 2 females, San Gabriel Canyon, Calif., July 27, 1935, 4 males and 8 females, Monrovia, Calif., July 27, 1935, and 4 males, San Diego, Calif., August 7, 1935, all collected by R. H. Beamer; 6 males and 6 females collected by Jack Beamer, Monterey, Calif., July 22, 1935.



Figs. 4–6.—Lateral and ventral views of male genital capsule and ventral view of sternal apodemes of (4) *Empoasca rubrarea*, n. sp., (5) *E. ruficeps* Van Duzee, and (6) *E. delta*, n. sp. × ca. 70.

Holotype male, allotype female, and 15 male and 14 female paratypes deposited in the Snow Collection, Lawrence, Kans.; 6 male and 6 female paratypes deposited in the U. S. National Museum (no. 53287); and 6 male and 6 female paratypes in the collection of the entomological laboratory of the Bureau of Entomology and Plant Quarantine, Arlington Experiment Farm, Arlington, Va.

Empoasca ruficeps Van Duzee Fig. 5

Empoasca ruficeps Van Duzee, Proc. California Acad. Sci. 7 (ser. 4): 304–305. 1917.

External characters.—Small, yellowish green, mottled with brown, with pronotum and scutellum marked with sanguineous-brown, and apex of fore wing deeply infuscated, with strong pale nervures. Length 3.5 mm.

Male internal structures.—Lateral process in lateral view curving dorsocaudad, basal half with sides almost parallel margined, apical half slightly broader, terminating in a blunt point directed caudad; in ventral view the lateral processes are long, curving first mesad and crossing near middle, extending slightly laterad, then caudad, broadening distally, then tapering to bluntly pointed, overlapping apices directed laterad. Dorsal spine broad at base, deeply concave on cephalic margin, with sharply pointed apex directed cephalad. Aedeagus narrow at base, enlarged distally. Sternal apodemes medium sized, bluntly rounded distally.

Van Duzee described *ruficeps* from 30 specimens collected at Los Altos, Calif., July 26, 1916, on pitcher-sage (*Sphacele colycina*), and at Westpoint, Mount Tamalpais, 1,300 feet elevation, August 16, 1916. The drawings (Fig. 5) were made after examining male and female paratypes received from Van Duzee, 1 female collected at Mount Diablo, Calif., June 21, 1935, by Oman and compared by him with the type, and 5 males and 5 females collected at Lockwood, Calif., July 25, 1935, by R. H. Beamer.

Empoasca delta, n. sp. Fig. 6

Resembling *ruficeps* somewhat in general appearance, but smaller, with pronotum and scutellum yellowish green and less marked with sanguineous-brown, and apex of fore wing less deeply infuscated. Genital characters distinct. Length 2.5–2.75 mm.

External characters.—Crown tinged with orange, with a pale spot on each side near eye and a pale median area, sometimes constricted in middle, forming a pale spot at apex and one at middle of posterior margin. Pronotum yellowish green, with three paler areas near anterior margin, the middle one outlined by a dark line on each side and the lateral areas each surrounded by several dark-brown dots. Scutellum yellowish green, with a median white area and a transverse row of three pale points just below the incised line, the apex terminating in a conspicuously dark-brown point. Fore wing subhyaline, yellowish green, mottled with brown, sometimes with orange, with a small rufous-brown spot near tip of clavus; apex fuscous, with pale nervures. Posterior margin of seventh sternite of female rather strongly produced from prominent lateral angles.

Male internal structures.—Lateral process long, curved, relatively stout, with sides parallel to near apex; in lateral view distal portion slightly en-

larged and terminating in a short fingerlike process curved downward; in ventral view distal portion angularly bent on inner margin and curved on outer margin to sharply pointed apex directed mesad. Dorsal spine stout, tapering to a sharp point, curved cephalad. Aedeagus broad distally. Sternal apodemes medium sized, bluntly rounded distally, with apices more widely separated than in *ruficeps*.

Holotype male, allotype female, and numerous paratypes of both sexes from Delta, Calif., June 28, 1935, P. W. Oman, collector. Types, U.S.N.M. no. 53288. Twelve paratypes deposited in collection of the entomological laboratory of the Bureau of Entomology and Plant Quarantine, Arlington Experiment Farm, Arlington, Va.

Empoasca mexicana Gillette

Empoasca mexicana Gillette, Proc. U. S. Nat. Mus. **20**(1138): 737–738. 1898.
Empoasca bitubera DeLong, Ohio Journ. Sci. **32**(4): 395. 1932. (New synonymy.)

As previously mentioned, *mexicana*, because of the more rounded crown and the pale nervures of the fore wing, belongs in the *alboneura* group, but the writer treats it here in order to establish the synonymy indicated.

The original description of *mexicana* by Gillette was based on 5 females collected near Veracruz, Mexico, type no. 3430, U. S. National Museum. Later DeLong[9] redescribed specimens "as apparently this species" and illustrated the male genitalia from a series in the U. S. National Museum collection consisting of 5 females and 3 males collected at Marfa, Tex., June 5, 1908, by Mitchell and Cushman, stating that Gillette's type could not be located in the National Museum. From an examination of this series now extant, consisting of 1 male (dissected), 3 females, and 2 specimens with abdomens missing, the external markings and internal structures of the male were found to be identical with those described and figured later by DeLong for *bitubera*. *Empoasca bitubera* is therefore placed as a synonym of *E. mexicana* Gillette.

[9] U. S. Dept. Agr. Tech. Bull. **231**: 56–57. 1931.

MAMMALOGY.—*A new badger from Sonora.*[1] E. A. Goldman, U. S. Bureau of Biological Survey.

The badgers of the widely dispersed species, *Taxidea taxus*, are divisible into several closely allied geographic races. One of these, hitherto unrecognized, from near the southern known limit of the species along the eastern side of the Gulf of California is described as follows:

Taxidea taxus sonoriensis, subsp. nov.

Type.—From Camoa, Rio Mayo (about 15 miles above Navojoa), Sonora, Mexico. No. 96211, ♂ young adult (frontoparietal sutures fused), U. S. National Museum (Biological Survey collection); collected by E. A. Goldman, November 29, 1898. Original number 13263.

[1] Received June 1, 1939.